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Occurrence of the Parasitic Branchiuran, *Argulus alosae*, on Dying Atlantic Menhaden, *Brevoortia tyrannus*, in the Connecticut River

Dying adult Atlantic menhaden *Brevoortia tyrannus* (Latrobe) infested with the parasitic branchiuran *Argulus alosae* Gould were collected from the Connecticut River at Old Saybrook, Connecticut, on 26 September 1970. Examination of 50 dying menhaden (average 300 mm fork length) showed that each was heavily infested with argulid fish lice. Dead menhaden were scattered along the shore and in the river. This is the first reported occurrence of *A. alosae* on menhaden (Roger F. Cressey, U. S. National Museum, personal communication).

A. alosae is probably of economic importance since heavy infestations of other fish lice species have destroyed entire fish populations in confined environments such as pools and lakes (Meehean, 1940). A review of the literature indicated that argulids can cause fish mortality in a number of ways. Argulids are free-swimming, and when attached to fish, feed on the host's blood. An overabundance of argulids that evidently resulted from a lack of predators of argulids and a dense concentration of gar, caused gar to die, probably from loss of blood, in a Florida pond (Kolipinski, 1969). Recurring fish mortality in a South Dakota lake has been attributed to argulid toxins and to the subsequent development of wounds where secondary infections occurred (Hugghins, 1959). The interaction of argulid infestations causing weakened fish and the presence of low oxygen levels evidently caused mortality of numerous fish in Minnesota (Anonymous, 1952). Fish death also may result from the behavior of fish when attacked by argulids. Wilson (1903) reported that roach and dace, when attacked by argulids, thrashed about and died within a day, probably as a result of physical exhaustion, whereas, sunfish accepted the parasites without a struggle and were able to withstand the argulids. We also observed *Caligus chelifer*, a copepod with feeding habits similar to those of argulids, caused menhaden to thrash about and die in a laboratory tank.

A total of 367 parasites, 363 *A. alosae* and 4 *Caligus chelifer* Wilson, or 14.7 parasites per fish were recovered from a sample of 25 preserved menhaden. We assumed parasites were lost when the fish were being collected and when some fish flipped onto the bottom of the boat, since fish lice rapidly leave their host if it dies or if it is removed from the water (Wilson, 1903; Hugghins, 1959). Therefore, 14.7 parasites per fish is probably a low estimate.

The behavior of many individuals and one school of menhaden was observed in the river. Each dying fish was alone and was flopping on its side while moving in small circles. The fish appeared to be trying to get out of the water, and we observed one dying menhaden swim onto the shore. A small school of slow-swimming adult menhaden (estimated 5,000 fish) allowed us to approach within a few feet of them. We observed two menhaden leave the school and flop at the surface; both were captured and each was heavily infested with fish lice. Erratic behavior was observed by Westman and Nigrelli (1955) in dying adult menhaden collected near New York Harbor but the cause of mortality was not determined. They did, however, suggest that parasites in conjunction with abnormal environmental conditions such as lowered salinities or high tem-

peratures can cause menhaden mortality. Since no environmental measurements were taken in the river, we do not know their effects, if any, on the menhaden mortality.

In the Connecticut River a dense concentration of adult menhaden created conditions favorable for a parasitic outbreak. Commercial fishermen at Old Saybrook, Connecticut reported unusually large numbers of adult menhaden schools in the river during the week of 14–20 September 1970. Aerial surveys also showed many large schools of adult menhaden in the river during this time. These high densities of fish are conducive to a parasitic outbreak and local fishermen indicate there has been mortality during the fall for the last 4 years.

In summary, we believe the abnormal behavior of adult menhaden in the Connecticut River may have resulted from irritation caused by *A. alosae*. We feel that menhaden, like roach and dace, may be hypersensitive to attacks by fish lice and that physical exhaustion resulting from parasite irritation caused the mortality of menhaden in the river.

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RICHARD L. KROGER

JAMES F. GUTHRIE

National Marine Fisheries Service
Atlantic Coastal Fisheries Center
Beaufort, North Carolina 28516